REMARKS

Claims 1-20 are rejected under 35 USC 103(a) as being unpatentable over Hui *et al.* in view of Gerstacker. Claims 1, 11 and 20 are amended hereby. Claims 4 and 14 are cancelled, without prejudice. Consequential amendments are made hereby to claims 2, 3, 5 12, 13 and 15. Basis for the amendments to claims 1, 11 and 20 can be found on page 8 of the specification at lines 8 to 19.

With these amendments, claims 1, 11 and 20 are limited to an arrangement, a method or a program including "a noise estimator for producing from the received signal (y) iteratively at each iteration K an estimated vector of noise samples $\underline{\hat{b}(K)} = \underline{y} - H \cdot \underline{\hat{p}(K-1)}$, where H is a matrix depending on known symbols, computing from the estimated vector of noise samples a vector of noise covariance taps $\underline{r(K)} = win_k \cdot \sum_{l=k}^{L_y-1} b_l(K) \cdot b_{l-k}(K)^*$ where win_k is a windowing function with a positive Fourier transform, and using the vector $\underline{r(K)}$ to produce a new matrix $W(K)$ representing the inverse of noise covariance, and

said channel impulse response estimator is arranged, at each iteration (K), to respond to said new matrix $W(K)$ representing the inverse of noise covariance to produce a single improved channel impulse response estimate $\underline{\hat{p}(K)} = (H^H \cdot W(K) \cdot H)^{-1} \cdot H^H \cdot W(K) \cdot \underline{y}$."

Cited prior art – Hui *et al.*

The arrangement and method disclosed in Hui *et al.* for iterative channel impulse response estimation starts from the premise that the noise is coloured and relies on whitening filters. Whitening filters introduce delay and may require higher sampling rate. The cost functions of the algorithms of Hui *et al.* could not work if the whitening filter delay is greater than the number of known transmitted symbols minus the length of the estimated channel impulse response.

The Examiner recognises that Hui *et al.* does not expressly teach that the noise estimate should comprise comprises a matrix $W(K)$ representing the inverse of noise covariance. However the Examiner maintains that in analogous art, Gerstacker *et al.* teach estimating the impulse response using the inverse of noise covariance (see page 3, lines 28 - 55).

Cited prior art – Gerstacker *et al.*

The passage of Gerstacker *et al.* at page 3, lines 28 – 55 is a mathematical analysis of the characteristics of a transmission channel. Gerstacker *et al.* then derives and discusses various methods of channel impulse response estimation, including that:

1) The autocorrelation matrix of the noise Φ_{nn} can be simplified to $\Phi_{nn} = \sigma_n^2 E_{N-L+1}$ (page 3 line 45, equation 10), where σ_n^2 is the noise variance (not covariance), enabling a maximum likelihood channel estimated value to be obtained with an optimum training sequence leading, for GSM or EDGE to an estimation $\hat{h}_{ML} = \frac{1}{N-L+1} A^H r$ (page 4 line 20, equation 13).

2) after ML channel estimation a weighting of the ith obtained channel estimated value should be undertaken using the factor $d[i] = \frac{\sigma_i^2}{\sigma_i^2 + \sigma_n^2/(N-L+1)}$ (page 5 line 35, equation 21)

3) that difficulties arise because "determining the weighting factors *d* [*i*], which are used to determine the MAP estimated values $\hat{h}_{MAP}[i]$, also requires knowledge of the noise variances , which can be estimated using ML channel estimation via simulation of the received user signal, and likewise a variance of the corresponding channel coefficients which is, in general, not accessible to the receiver." (page 5 lines 53 to 56).

4) these difficulties can be solved (prior art) "by setting to zero in a hard fashion in a post-processing unit estimated channel coefficients which fall below a threshold" (page 6 lines 4 to 5).

5) the difficulties can be solved (according to Gerstacker *et al.*) by "Firstly, channel estimated values are obtained in the receiver for the pulse response of a transmission channel from a received corrupted data signal, and thereafter the noise variance is estimated. Subsequently, the obtained channel estimated values are weighted with the aid of factors which have a continuous functional relationship with the obtained channel estimated values which depends on the noise variance." (page 6 lines 28 to 33).

In summary, the teaching of Gerstacker *et al.* is that the autocorrelation matrix of the noise Φ_{nn} should <u>not</u> be used directly but should be simplified by using the noise variance σ_n^2 instead.

Comparison with present claims

There is no suggestion in Gerstacker *et al.* that improved channel estimates could be obtained using an arrangement or method including "producing from the received signal (y) iteratively at each iteration K an estimated vector of noise samples $\underline{\hat{b}(K)} = \underline{y} - H \cdot \underline{\hat{p}(K-1)}$, where H is a matrix depending on known symbols, computing from the estimated vector of noise samples a vector of noise covariance taps $\underline{r(K)} = win_k \cdot \sum_{l=k}^{L_y-1} b_l(K) \cdot b_{l-k}(K)^*$ where win_k is a windowing function with a positive Fourier transform, and using the vector $\underline{r(K)}$ to produce a new matrix $W(K)$ representing the inverse of noise covariance", as claimed in amended claims 1, 11 and 20.

Gerstacker *et al.* does not teach "computing from the estimated vector of noise samples $\underline{\hat{b}(K)} = \underline{y} - H \cdot \underline{p(K-1)}$ a vector of noise covariance taps $\underline{r(K)}$, as specified in claims 1, 11 and 20, but teaches using the noise variance σ_n^2. Iteration, as specified in claims 1, 11 and 20, is not part of Gerstacker's teaching, which refers only to a single stage calculation based on a single training sequence, without reference to iteration.

Accordingly, combination of Gerstacker *et al.* with Hui *et al.* would not lead to the invention of present claims 1, 11 and 20 since Gerstacker *et al.* teaches away from any such combination.

Regarding claim 2, the Examiner maintains that Gerstacker *et al.* teaches that an inverse noise covariance matrix is calculated iteratively. However, Applicant submits that Gerstacker *et al.* nowhere refers to iteration of his calculation, let alone the computation at each iteration of a new inverse noise covariance matrix, that is to say one set of estimated noise samples (not a plurality) at each iteration, as required by present claim 2.

It is submitted that claims 1, 11 and 20 are novel and non-obvious in view of the prior art cited and are allowable. In particular, it is submitted that these improvements in reduced calculation complexity are not foreshadowed by the prior art cited and are not obvious. The other claims depend from claim 1, 11 and 20 and are submitted to be allowable at least for this reason.

Although Applicants may disagree with statements made by the Examiner in reference to the claims and the cited references, Applicants are not discussing all these statements in the current Office Action since reasons for the patentability of each pending claim are provided without addressing these statements. Therefore, Applicants reserve the right to address these statements at a later time if necessary.

No amendment made herein is related to the statutory requirements of patentability unless expressly stated herein. Further, no amendment herein is made for the purpose of narrowing the scope of any claim, unless Applicants have argued herein that such amendment was made to distinguish over a particular reference or combination of references.

If Applicant has overlooked any additional fees, or if any overpayment has been made, the Commissioner is hereby authorized to credit or debit Deposit Account 503079.

Respectfully submitted,

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